from the Author

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THE INTRODUCTORY LECTURE TO A COURSE OF NATURAL PHILOSOPHY,

DELIVERED

IN THE THEATRE OF THE MEDICAL SCHOOL,

BREWER-STREET, GOLDEN-SQUARE.

By EDWARD BROWNE, F.L.S.

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INTRODUCTORY LECTURE.

In the distribution of the several subjects which enter into the course of medical and scientific instruction delivered in this place it has devolved upon me, Gentlemen, to explain to you the principles of natural philosophy, to point out the necessity of a knowledge of those principles, for the successful cultivation of some other departments of science; and more especially to demonstrate, the primary importance of this knowledge to the student of medicine and surgery.

It is not however to the youthful aspirant for the honours of the medical profession alone, that this science presents attractions, or offers more solid advantages; indeed, while I regret that it should be so, I fear we must admit that the members of our profession generally are less familiar with this branch of philosophy, than many who possess only that general knowledge of the sciences which constitutes in the present day an essential part of the education of a gentleman.

The progress of intellectual improvement is marked at present, by a new and most important peculiarity—the diffusion of existing knowledge amongst the mass of mankind. Can it be necessary that I should adduce any proof of this? Need I remind you of the numerous Literary and Scientific Institutions with which this metropolis abounds? Institutions for the most part yet in their infancy, some in their adolescence, but all promising a vigorous and perpetual manhood, of which the fabled existences of the heathen mythology afford the only, but imaginary parallel. All intellectual prototypes of Hercules in the cradle. The attacks of the serpent Error, and of Prejudice, are all which they have to repel, and these are fast expiring in their infant grasp, and unfolding those coils at their feet which have so long encircled the human intellect and enfeebled its exertions.

I feel that I cannot impress this fact too forcibly on the minds of the junior portion of my medical hearers. They are no longer entering a profession whose mysteries are sacred. They are no longer shielded from the criticism of their employers, by the magical influence of a license from Apothecaries' Hall, of a diploma from the College of Surgeons, or even by the more dignified distinction of a University degree. Several cases have come to my knowledge, in which patients amongst the educated classes of society have detected the want of physical and even of chemical knowledge in their medical attendants. You will perceive therefore that ignorance of the sciences collateral to medicine is no longer safe. The hour is fast approaching, if indeed it has not already arrived, when the half-educated man will be unable to obtain even a subsistence amongst us.

The veil of the temple of knowledge is rent in twain! The arcana of nature are no longer communicated through the dark and doubtful medium of an oracle, but are accessible to all who will patiently and diligently investigate them. The source of the waters of knowledge is discovered, and you are invited to drink at the fountain-head. The path which leads to it is that of experimental inquiry.

To point out this path to your footsteps, and to accompany you a short distance on your journey, is the task which I have undertaken to perform. To find you zealous and diligent in the pursuit of it, is the highest reward I can enjoy. You will have an opportunity in this place of becoming acquainted with the general principles of science, and with so much of its details as are already generally known; but I charge you, my young friends, to reflect that the spirit of philosophy requires that you should repay the pains bestowed upon your education by eliciting future discoveries. You are not to rest satisfied with the information which you may obtain from others, but on the contrary you are bound to contribute, though it be but your mite, to the treasury of useful knowledge. This the world will expect, this your profession has a right to demand from you; for it affords you facilities for the cultivation of every branch of knowledge, which can be derived from no other source. A few words of explanation will suffice to convince you of this.

All the subjects on which the human mind can be employed, independently of revelation, may be referred to two general heads. —Science or Philosophy and Natural History.

The first of these two fundamental divisions includes physics or natural philosophy, chemistry, which is sometimes called experimental philosophy, physiology, or the science which explains to us the laws of life, and metaphysics, or ontology, which embraces the consideration of the active and intellectual powers of the human mind.

Gentlemen, the course of your studies must include all these, or your medical education will be incomplete. Natural philosophy, chemistry, and physiology, are separately taught in all schools of medicine, except those established in this metropolis, where the omission of the first imposes on the teacher of chemistry the necessity of making a brief exposition of its principles, introductory to the proper subject of his course, and this omission is the more extraordinary, as Great Britain is the only country in which the possession of natural-knowledge is implied in the very name of the physician. Such, however, is the fact.

In the cultivation of these branches of science, reference is necessarily made to measures of number and dimension, and hence has arisen a secondary science, called mathematics or the science of quantity.

I am not aware that the philosophy of the human mind has yet been made a separate article of medical education, but the reference which must be made to the subject in the lectures on the practice of medicine under the head of insanity, and the influence of the mind upon the body, will convince you that it must not be altogether neglected.

There is one subject which is considered as belonging to the science of mind, to which I would call your attention more particularly, because the evidence on which it is supported is derived alike from every department of science and natural history—it is natural theology. The cells of the honey-comb are constructed upon strictly mathematical principles, and who we may inquire instructed the bee to solve problems of maxima and minima. The proofs derived from the four fundamental departments of science are innumerable, and so clear that he who runs may read, hence the medical man has no excuse for being ignorant of them, and if, as I can scarcely conceive, there should be one who can resist the conviction they are calculated to bring home to the mind, it would be charitable to say of him "*quem Deus vult perdere, prius dementat.*"

We come now to the consideration of natural history; this division of the objects of our study, refers to what have been termed the three kingdoms of nature, the animal, the vegetable, and the mineral: perhaps a more philosophical division would be into the earth, of which minerals may be considered as detached portions, and its inhabitants endowed with animal or vegetable life.

To convince you of the necessity for making the study of natural history a branch of medical education, I need only remind you, that your therapeutical agents, the weapons with which you must encounter disease, are supplied alike by each of its subdivisions.

It is not, however, as the members of a particular profession, exclusively, that you are interested in this subject, but as votaries of science in general; natural history provides us with the individual examples by which the laws of natural philosophy, chemistry and life are severally illustrated: and on the other hand, what will be the extent of your knowledge of natural history without the aid of science? How can you cultivate an acquaintance with mineralogy, without reference to the physical properties, and chemical relations of minerals ?—how will you prosecute the study of botany or zoology, without some knowledge of the laws of vegetable and animal life ? You may indeed accumulate a long list of the names of stones, and plants, and animals, but this is all. The torch of science alone can guide you to the " *Ultima Thule* " of your search.

It is manifest then that the two great departments of human knowledge—natural history and science, are intimately connected and mutually dependent on each other. They are twin sisters, and like the interesting strangers who have recently visited this country from the banks of the Ganges, they may not be separated without serious, perhaps fatal injury to both.

This mutual dependence of the several departments of knowledge on each other, gives to him who has taken a comprehensive view of the whole peculiar facilities for the cultivation of any particular branch ; and hence the medical philosopher derives the vantage ground on which he ought to stand. It is his privilege to exert the highest faculties of the mind, for the noblest of all sublunary purposes—the relief of disease—the mitigation of the pangs of death, while the very exercise of these privileges opens to him sources of the most sublime gratification in the indulgence of the best and kindliest feelings of his nature. To restore to his family and to his friends one who has been the subject of a painful operation, or of a dangerous disease, is a pleasure peculiarly our own ; and even when this is denied us, to smooth the descent to the grave, by pointing to the brighter prospects beyond it, to soften the pillow of death, and to console the widow and the fatherless survivors in their affliction, are duties, which, however melancholy in their performance, we may be grateful that we are permitted to share with the ministers of Him who made us—of Him whose only earthly occupation it was to heal the sick—to cleanse the leper—to give sight to the blind—and to say to the helpless cripple, Arise, take up thy bed and walk.

This hasty glance at the intimate connexion of the several departments of knowledge, is all that we can be permitted to take at present.

I must now proceed to point out the sources from which the study of natural philosophy derives its interest, and the practical application of its principles to purposes of utility, which invest it with importance.

To those who are desirous of cultivating an acquaintance with the sciences for their own sake, or as branches of general education, it will be sufficient to show that the laws of physics govern every phenomenon of nature and art in which there is any sensible motion. Over the majority of natural phenomena, they preside alone. Thus they regulate the motion of the earth, the ebbing and flowing of the tides, and the elevation of the waters of the ocean, by the action of the sun's rays, to form clouds, that impelled by the winds, in obedience to the same laws, are scattered over the face of the earth, again to descend upon it in refreshing showers, clothing it with verdure and invigorating it with life—or in the form of more violent rain, of hail or snow, to take part in the warfare of the elements, and to mingle with the horrors of the storm. It is here that the principles of natural philosophy are developed in their most sublime supremacy—here, where the uneducated man sees nothing but confusion, the mental vision of the philosopher penetrates the obscurity at once, and perceives established order riding on the wings of the tempest, controlling its course, and wielding he lightning of heaven.

If we turn to contemplate the products of human ingenuity, we shall find that the civil and military engineer, the naval and terrestrial architect, the machinist and the manufacturer, the maker of wheel carriages, and of the implements of husbandry, and those who are employed in the use of them, are all guided in the pursuit of their several occupations by the laws of natural philosophy. Lord Bacon has justly denominated it "*the root of the sciences, and of the arts,*" for it is by the study of its abstract principles in the closet, and the subsequent application of them to purposes of practical utility, that the arts have been brought to their present state of perfection. Sound theory is always in advance of practice, not only because it is necessary that men should first perceive the possibility of improvement before it can be carried into effect, but also, because their first efforts have been too often attended with disappointment, even in those cases where the most brilliant success has ultimately crowned their exertions. In proof of this, we may select as examples, the repeated unsuccessful applications of the power of steam, and the application of the Catenarian curve, once only a pleasing mathematical exercise to the construction of suspension bridges, connecting the summits of mountains with each other, or thrown across a broad and rapid river, as we see at Hammersmith, or projecting into the bosom of the ocean, as in the chain pier at Brighton. I mention these structures, because they will be familiar to most of my hearers; and the last is celebrated for the disasters which attended its construction; but it is now complete, and promises to be as durable as it is elegant.

Surely such examples should prevent us from sinking into despondency with regard to any undertaking, whose progress is guided by the principles of science; and hence we may indulge a reasonable hope, that the most magnificent project of our nation and of our age, the design of conveying an arched road way beneath the bed of a deep and rapid river, which has already proceeded to a considerable extent, in the case of the Thames Tunnel at Rotherhithe, will yet, at no distant period, be carried to a triumphant termination, in despite of the untoward circumstances which have hitherto retarded its completion. For it is inconceivable that the people of England will allow it to be said, that a work of this national character, is capable of exciting more interest among foreigners, than among themselves, or that they will sit down tamely under the imputation that they want the hand or the heart to execute the achievements which their genius can conceive.

It is not only in modern times that the principles of physical science have conferred benefits on mankind, or immortality on those who have devoted their lives to the cultivation of them. The stupendous aqueducts of ancient Rome, have transmitted to us the memory of their founders, embalmed in the gratitude of their countrymen. Their very ruins excite our admiration, and forcibly recalling to the imagination the labours of the Titans, diminish our surprise that the fables which described them should have gained belief. Would you inquire how the want of these superb and costly structures is supplied in our own cities? It is by the unobtrusive and economical, but far more effective arrangement of iron conduits, the material of which was known to the Roman architects only as an useless stone or earth—if, indeed, it was known to them at all ; for it is now well ascertained that the building of the aqueducts was not resorted to by them from ignorance of the law, in obedience to which water seeks the level of its source at whatever distance it may be led from it, as some have supposed, but merely from the want of more simple means of conducting it.

Over military affairs, too, this science held sway. Archimedes, the master mind of antiquity, defended his native town against the assaults of the Romans, entirely by the force of his mechanical genius. Such was the terror inspired by his engines, that the appearance of a beam with a rope attached to it, on the walls, was at all times sufficient to drive the assailants from their posts, until at length so strong a sense of security pervaded the minds of the beseiged, that on the celebration of a public festival, the ramparts were left undefended, the Romans entered the city, surprised and subdued the inhabitants, and slew the philosopher in his study, in opposition to the express commands of their general.

To this patriach of science we are also indebted for the means of ascertaining the specific gravities of bodies, by weighing them when immersed in water, and comparing the weight of the water displaced with the obtained weight when the body given is weighed in air. The idea appears to have struck him as he reclined on the liquid support of the bath, and it is reported that he was so transported with the feelings excited by his discovery, that he instantly sprung from the water, and rushed home unmindful of his nakedness, exclaiming, Ευρηκα Ευρηκα, I have found it, I have found it. His mind was intent upon the numerous and important uses to which he foresaw it might be applied. Among the more immediate, but minor circumstances, it enabled him to detect the fraud committed by a goldsmith, who, having been furnished by Hiero, king of Syracuse, with a quantity of gold, for the purpose of making a crown, purloined a part of it, and replaced it with an equal quantity of silver.

The subject of specific gravities leads us directly to consider the connexion of natural philosophy with chemistry. Chemical manipulation consists entirely of a series of physical operations. Such are the various processes by which masses are reduced to powder, and the mode of separating the coarser parts from those which are finer, by diffusing the whole through some fluid in which they are insoluble ; the coarse parts presently subside, and the supernatant liquid in which the finer portion is still suspended, may be removed by the action of the syphon. The phenomena of evaporation, and the extent to which it may be modified, by the diminution or removal of the atmospheric pressure, which has been applied to a considerable extent in some manufacturing processes, as in the boiling of sugar, and in the preparation of the vegetable extracts employed in pharmacy, are also examples of the fact. The chemical agencies of light, heat and electricity are not less numerous and important. In the first the genius of Wollaston has provided the pharmaceutical chemist, with the ready means of testing the purity of his essential oils by ascertaining their power of refracting the rays of light. The influence of the second is all but universal, and the last, in the hands of Davy, has almost erected chemistry into a new science.

I have already had occasion to mention, that in this metropolis the medical student derives the scanty knowledge of natural philosophy, which is accessible to him, from the preliminary explanations which the teacher of chemistry is obliged to enter upon, before the proper subject of his course can be made intelligible to his hearers. This circumstance is a source of some inconvenience and obscurity. Students frequently confound physical with chemical phenomena, and few of them have a distinct idea of the mode in which a physical change contributes to the production of a chemical combination ; for example, if alcohol be distilled with sulphuric acid, a compound called æther is produced, and the student having prepared this substance, is content to say, that he has performed a chemical experiment, without once referring to the fact that the chemical combination of these bodies has been merely favoured by the state of minute subdivision in which they were presented to each other, while their elevation in the form of vapour, and their subsequent condensation in the receiver being mere changes of state, are strictly physical phenomena ; for if the resulting compound be distilled again, the same physical changes take place without affecting its chemical composition. I have selected this example on account of its simplicity, but there is scarcely an instance in which any chemical union or decomposition takes place without some concomitant physical phenomena; and as I conceive it to be essential to your perfect comprehension of any complicated operation of this kind, that you should have clear ideas of the nature of the phenomena which they present, and be able to trace distinctly the several stages of their progress, I propose to direct your attention in a particular manner to the distinction between physical and chemical action in those processes which involve them both.

You will perceive that a knowledge of natural philosophy, is requisite to enable you to understand the phenomena of chemistry. An acquaintance with both these sciences is necessary for the investigation of the principles of physiology. Vital phenomena are the most complicated which science can present to us; take the function of respiration for example, you will find that it embraces the phenomena of physics, chemistry, and life. But although some of the vital functions require the aid of chemistry for their illustration, there are others in which physical and vital action only are concerned, as in the performance of muscular motion, and some of which are referable to natural philosophy alone. I would recommend the study of these to you, in the eloquent language of Dr Arnott, as far more effective than any persuasion which I could employ. He describes the medical man as the engineer pre-eminently, and demands " where shall we find to illustrate mechanics a system of levers and hinges, and moving parts, like the limbs of an animal body, where such an hydraulic apparatus as the heart and blood vessels, such a pneumatic apparatus as the breathing chest, such acoustic instruments as the ear and larynx, such an optical instrument as the eye, in a word such mechanical variety and perfection as in the whole of the visible anatomy?" We shall also have occasion to show that the philosophy of imponderable substance is illustrated by the phenomena of animal heat, and by the functions of the brain and nerves. You will most of you be aware that many physiologists have laboured to establish the indentity of the electrical and nervous fluids, and that on the other hand it has been urged that we have not yet obtained sufficient evidence in support of this position to enable us to decide on its validity. I certainly am not disposed to go so far as those who have asserted that electricity and life are modifications of the same principle, but I do believe it to be the medium through which the unknown principle of life acts upon the material structures of the body, and I hope to be able to lay before you satisfactory evidence, derived from experiment, in support of this opinion.

If then the science of chemistry be based upon natural philosophy, it is equally evident that the superstructure of physiology is raised upon both. From this it follows that a previous knowledge of physical principles affords great assistance to the student in the investigation of the more complicated sciences; with it indeed he seems to learn by intuition—the facts which are presented to his mind seem to arrange themselves in their natural order under the several heads to which they belong; whereas he who would study chemistry or physiology without such preparation, either fails to obtain clear ideas of the subject at all, or loses more time in attempting to unravel the confusion they are involved in, than would have served to obtain a knowledge of the whole body of physics, which it may be observed offers by far the greatest sum of knowledge, which a given amount of labour will suffice to accumulate.

It is obvious that the principles of natural philosophy can have no direct relation to the science of mind, but inasmuch as we are indebted to them for the instruments of our intellectual arts, such as writing, printing, drawing, painting, music and sculpture; and for our mathematical and philosophical instruments, it cannot be denied, that it is at least indirectly connected with this, as well as with the other departments of science.

Hitherto we have considered the study of natural philosophy in its relations to the other departments of science, as part of an extended scheme of liberal education, such as a man of rank and fortune would wish to confer upon his son, that his acquirements might be equal to his station in society. It only remains that I should point out the importance of its applications to the practice of medicine and surgery; and here I may observe that it is by no means the least of the advantages which we derive from our profession, that it places us (in an intellectual point of view) on a level with the wealthy and the great. It has been asserted, however, that this study is not of primary importance to a medical man; but after what has been said of its connexion with physiology, it can hardly be necessary, I imagine, to enter upon a formal refutation of so palpable an error, as far as regards the scientific information which is required of us. But I must remind you, that our profession is an art as well as a science, and that in the common routine of private practice you will have daily occasion to avail yourself of the aid of physics. Are not all the instruments in the hands of the surgeon, or of the obstetrician, really mechanical tools? If so, a certain degree of dexterity must be required for the manipulation of them, the acquisition of which should form part of a course of medical instruction; to place this point fairly before you, let us compare it with some other mechanical occupation. If a carpenter takes an apprentice, the first lesson he teaches him is to handle the tools of his trade, whereas with us, I regret to say, that few of our instruments are ever removed from their cases, except when they are to be employed for the performance of an operation on the living body. And what is the consequence of this neglect? Those operations that can be performed with the scalpel, with which we become familar by dissection, are well and dexterously performed, but when any other instrument is required, alas! what a falling off is there. Let us take amputation, for instance. How often do we see the bone splintered just as its division is completed, and the blame attributed to the awkward and inefficient manner in which the assistant supported the limb, when it would be much more justly bestowed upon the surgeon for the awkward manner in which he held the saw. Mechanical manipulation is indeed of the utmost importance to the surgeon, and may be so easily acquired by some amusing work of carpentry, that it is folly or idleness to omit it.

Again, I presume that no one will venture to deny that we should understand the construction of the instruments which we are constantly using; and we shall find upon inquiry, that they comprise all the simple machines or mechanical powers. These are the lever, the wheel and axle, the inclined plane, the wedge, the screw and the pulley.

The punch for extracting the stumps of teeth, is as complete and simple a lever as a common crow bar; and the tooth forceps, consist in fact of two levers, of which the rivet that connects them is the common fulcrum; this instrument well illustrates the advantage of mechanical tools. In the first place, the tooth is seized by the iron jaws of the forceps, instead of between the fingers, then it is grasped with the force of the whole hand, and lastly, this force is multiplied many times by the difference between the length of the claws and handles of the forceps. The wheel and axle find their representative in the tooth-key, for it matters not whether the wheel be entire or reduced to a single spoke, its action is the same. The inclined plane supports our fractures,—our cutting instruments are wedges,—the tourniquet owes its power to the screw,—and the pulley is employed by us for the reduction of dislocations. Can it be said then, that a knowledge of the principles upon which the usefulness of these various instruments is founded, is at best but of secondary importance to you; or is there one amongst you who would be content to use them without inquiry, merely because others have done so before you? If there be such a person, I have yet another argument in reserve for him.—The improvement of our instruments must be effected by ourselves, and we cannot expect to improve what we do not understand. Would you learn the extent of the benefits which may be conferred upon suffering humanity by this means; I refer you to my esteemed colleague Mr. Costello, who has had the honour of introducing to the notice of the profession in this country, the mode of destroying calculi in the urinary bladder by mechanical means, which has long been adopted in France, and thus saving the patient from the horrors of lithotomy, avowedly the most formidable operation in domestic surgery, which even Cheselden, whose mode of operating is yet unequalled, never undertook without reluctance, approaching, according to his own admission, to fear.

There is yet another point to which I would call the attention of my medical hearers; it has been asserted by some persons desirous of underrating the value of scientific attainments, that they have a direct tendency to contract the feelings, and impair the affections of the heart. An anonymous satirist even goes so far as to suppose that if he were to fall into a river, the uneducated savage would instantly plunge in to his rescue, but that the scientific civilized man, viewing him merely in the light of a projectile, and calculating the depth of the water, the force and direction with which he impinged upon its surface, and the resistance of the fluid medium, would probably point out the precise spot in the mud at the bottom at which his body might be found.

To the medical philosopher it is entrusted to refute this calumny. philanthropy is an essential part of his profession, and although I have dwelt upon this topic already, I cannot forbear to remind you that it is your business to console no less than to cure, and that the highest satisfaction which your pursuits can afford, must be derived from the extent to which your feelings are interested in them.

In conclusion, I have only to allude to the arrangement which I propose to adopt in the ensuing lectures. The course will be divided into three parts. In the first part, we shall consider those subjects which are comprehended by the term mechanical philosophy; in the second, we shall explain the philosophy of imponderable substance; and in the third we shall direct your attention to the sublime phenomena of physical astronomy. Each of these principal parts will be again subdivided into sections, at the end of each of which we shall enumerate all the applications of the subject to the practice of medicine and surgery of which it will admit, and then institute an examination, for the purpose of ascertaining that the explanations which have been given have been perfectly understood by the student.